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## CBRN PAPR Laboratory Respirator Protection Level (LRPL)

Mike Bergman

NIOSH/NPPTL Public Meeting

Hilton Garden Inn, Canonsburg, Pa





- Description- Fit-factor corn oil aerosol test
- Purpose- Establishes a benchmark level of protection under laboratory conditions
- Not intended as an indication of protection in an actual response scenario





#### **Challenge Aerosol Criteria**

- 20 40 mg/m³ Corn Oil aerosol
- 0.4 0.6 µm Mass Median Aerodynamic Diameter





#### Pass/Fail Level

- LRPL ≥ 10,000 for ≥ 95% of test trials
- Evaluated over 11 test exercises
- Tested with PAPR blower operating





# CBRN PAPR Laboratory Respirator Protection Level (LRPL) Subject Exercises

- 1) Normal Breathing
- 2) Deep Breathing
- 3) Turn Head Side to Side
- 4) Move Head Up and Down
- 5) Recite the Rainbow Reading Passage or equivalent

- + 6) Sight a Mock Rifle
  - 7) Reach for the Floor and Ceiling
- + 8) On Hands and Knees, Look Side to Side
  - 9) Facial Grimace
- + 10) Climb Stairs at a Regular Pace
  - 11) Normal Breathing
- + emergency response exercises





#### **Human Subject Anthropometric Parameters**

(applicable based on PAPR design)

- Neck Circumference
  - —(example: for tight-fitting neck dams)
- Head Circumference
  - —(example: for hooded models, 'Large' criteria)
- Face Length
  - —(example: for tight fitting face-masks)
- Face Width
  - —(example: for tight fitting face-masks)





- Anthropometric ranges established as part of CBRN Escape Respirator standard
- Ranges established through review of population data of head, neck, face length, and width sizes





- 'Face Length' and 'Face Width' Ranges
  - -Adapted from Los Alamos panel report Selection of Respirator Test Panels Representative of U.S. Adult Facial Sizes. LA5488. 1974





- Neck and Head circumference ranges are based on latest NIOSH research data by Zhuang, et. al.
- NIOSH survey conducted for purposes of establishing updated panels for NIOSH respirator certification and international standards
- Subjects recruited from industries nationwide (manufacturing, construction, health care, law enforcement, and firefighting)





- NIOSH survey: Total Subjects = 3,998
- 2,243 subjects (1,140 male and 1,103 female) had complete measurements for:
  - –Face Length and Width
  - Head Circumference
  - Neck Circumference





#### **CBRN PAPR LRPL Test Panel**

	Small	Medium	Large
	Cell A	Cell D	Cell G
Face Length and Face Width	Use LANL boxes 1, 2, 3, 4 (2 or 3 subjects each box, 2 trials per subject)	Use LANL boxes 3, 4, 5, 6, 7, 8; pane size 17 (2 or 3 each box, 2 trials per subject)	Use LANL boxes 7, 8, 9, 10; panel size 11 (2 or 3 each box, 2 trials per subject)
	Subjects= 10	Subjects= 17	Subjects= 11
	Trials= 20	Trials= 34	Trials= 22
	Cell B	Cell E	Cell H
Head Circumference	N/A	N/A	570-603 mm
	Subjects= 0	Subjects= 0	Subjects= 10
	Trials= 0	Trials= 0	Trials= 20
	Cell C	Cell F	Cell I
Neck Circumference	306-378 mm	355-403 mm	378-451 mm
	Subjects= 10	Subjects= 10	Subjects= 10
	Trials= 20	Trials= 20	Trials= 20

3 Size Model Test Each Column Corresponding with Unique Size

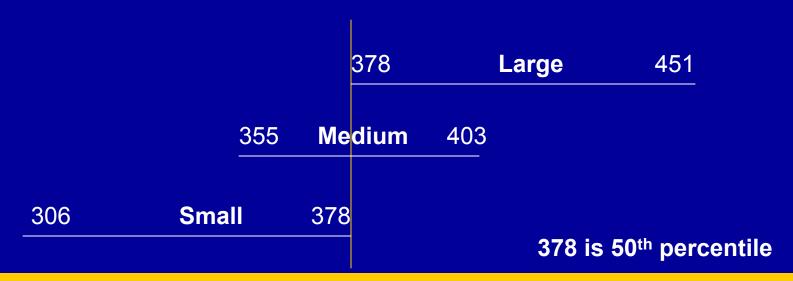
'One-Size-Fits-All' Test All Size Columns





#### Overlapping Size Ranges for Neck Circumference Using NIOSH Population Data

Expanded Neck circumference ranges increase the chance a subject will fulfill multiple ranges of anthropometric criteria.







#### CBRN PAPR Practical Performance

- Evaluated during Laboratory Respirator Protection Level testing
- Evaluates that the power switch is not accidentally switched off
- Evaluates that hoses and electrical wires do not tangle and cause the respirator facepiece or hood to move to an improper position, such as being removed
- Evaluates wear in accordance with manufacturer's user instructions





#### **Summary- Test Considerations**

 Possibility of facepiece particle concentration being affected by particles generated by PAPR blower lubricants





#### **Summary-Timeline**

- Develop Standard Test Procedures (May-June 04)
- Perform Verification Testing (August-September 04)



